

Diluted povidone-iodine versus saline for dressing metal-skin interfaces in external fixation

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ABSTRACT

Purpose. To compare infection rates associated with 2 dressing solutions for metal-skin interfaces.

Methods. 60 patients who underwent distraction osteogenesis with external fixators were equally randomised into 2 dressing solution groups (diluted povidone-iodine vs. saline). Fixations were attained using either rigid stainless steel 5-mm diameter half pins or smooth stainless steel 1.8-mm diameter wires. Half-pin fixation had one metal-skin interface, whereas wire fixation had 2 interfaces. Patients were followed up every 2 weeks for 6 months.

Results. Of all 788 metal-skin interfaces, 143 (18%) were infected: 72 (19%) of 371 in the diluted povidone-iodine group and 71 (17%) of 417 in the saline group. Dressing solution and patient age did not significantly affect infection rates. Half-pin fixation was more likely to become infected than wire fixation (25% vs 15%).

Conclusion. Saline is as effective as diluted povidone-iodine as a dressing solution for metal-skin interfaces

of external fixators. Saline is recommended in view of its easy availability and lower costs.

Key words: external fixators; infection; occlusive dressings; povidone-iodine

INTRODUCTION

Since the introduction of distraction osteogenesis by Ilizarov in the 1980s, its indications have extended to correction of bone deformity and treatment of non-union from fixation of open fractures.¹ Nonetheless, it is associated with major morbidities.^{2,3} Infection of the contact area between pins or wires and skin (metal-skin interface) is the most common problem, with incidences from 9 to 84%.^{4,5} Dressings help remove exudates produced by the wound and provide a barrier for the soft tissue tract that is exposed to the environment. Scientific evaluation based on standard dressing protocols are limited.^{6,7} The frequency of dressings, the level of sterility, and the need for trained nursing staff to perform the procedure remain



Figure A standard dressing set

controversial. There is no comparative study on the efficacies of various dressing solutions.⁸

Povidone-iodine remains one of the commonest antiseptic solutions for general wound dressings, despite its inhibitory effect on healing tissue in concentrations that are commonly used in clinical settings.^{9,10} Saline is cheaper and more easily available and provides a moist isotonic environment with no antibacterial properties. We compared the infection rates of metal-skin interfaces for external fixation in these 2 dressing solutions.

MATERIALS AND METHODS

Between June 2002 and July 2003, 46 males and 16 females underwent distraction osteogenesis using Ilizarov external fixators in our hospital. The ethics committee approved this study. Two females were lost to follow-up. The remaining 60 patients aged one to 76 (mean, 26) years included 24 Indians, 23 Malays, 12 Chinese, and one Bangladeshi. 22 patients were <14 years old, and 38 were older. 14 years was used as a cut-off age, because it was considered the age of skeletal maturity for boys and an indicator for surgery for congenital problems. 19 and 4 of these patients required correction for congenital or developmental deformities, whereas 4 and 37 were undertaken for trauma, respectively. The 60 patients were equally randomised into 2 dressing solution groups: diluted povidone-iodine (one portion povidone-iodine solution to 4 portions of boiled water) and saline.

Fixations were attained using either rigid stainless steel 5-mm diameter half pins or smooth stainless steel 1.8-mm diameter wires. Half-pin fixation had one metal-skin interface and was more commonly used for diaphyseal fixation, whereas wire fixation

Table 1
Grading of metal-skin interface infections

Grade	Description
0	No skin erythema and purulent discharge
1	Either skin erythema or purulent discharge
2	Both skin erythema and purulent discharge
3	Grade 2 plus radiological evidence of osteomyelitis

(using 110 kg tension) had 2 interfaces and was used for metaphyseal fixation. Patients (or their caretakers) were taught to perform dressings of the metal-skin interfaces using a standard dressing set (Fig.). Patients were discharged from hospital 2 to 3 days after surgery and the dressings were changed daily at home.

All patients were followed up every 2 weeks for 6 months (the end point of evaluation because some underwent removal of the frame at this stage). Wounds were evaluated based on a grading system developed in our institution. Grade 1 referred to the presence of either skin erythema or purulent exudates, grade 2 the presence of both, and grade 3 the presence of both plus radiological evidence of osteomyelitis (Table 1). The number of infections was calculated based on the location of the metal-skin interfaces (assumed to be independent), not the episodes of infection. Repeat evidence of infection at the same interface was considered to be one infection, and the most serious grade was counted. Episodes or durations of infection were not analysed, as patients' impression can be misleading and the number of observations varied. Simple relative risks with 95% confidence interval were calculated.

RESULTS

Of all 788 metal-skin interfaces, 143 (18%) were infected; 114 (80%) were grade 1, 27 (19%) grade 2, and 2 (1%) grade 3. Of the 27 grade-2 infections, 16 yielded positive cultures; 13 grew *Staphylococcus aureus*. Oral cloxacillin was prescribed to patients with grade-2 or -3 infection for one week. The half pins of the 2 grade-3 infections were removed. No patients had hypersensitivity reactions to either solution.

Dressing solution and patient age did not significantly affect infection rates. 72 (19%) of the 371 metal-skin interfaces in the diluted povidone-iodine group were infected, whereas 71 (17%) of the 417 metal-skin interfaces in the saline group did so (relative risk [RR], 1.14; Table 2). 55 (17%) of 333 metal-skin interfaces in patients aged <14 years were

Table 2
Comparison of infection rates according to dressing solution, patient age, and fixation method

Parameters	No. of infections/interfaces (%)	Relative risk (95% CI)
Dressing solution		1.14 (0.85–1.53)
Diluted povidone-iodine	72/371 (19)	
Saline	71/417 (17)	
Patient age		0.85 (0.63–1.16)
<14 years	55/333 (17)	
≥14 years	88/455 (19)	
Fixation method		1.61 (1.20–2.17)*
Half pin fixation	59/239 (25)	1.20 (0.77–1.87)
Diluted povidone-iodine	32/119 (27)	
Saline	27/120 (23)	
Wire fixation	84/549 (15)	0.73 (0.49–1.08)
Diluted povidone-iodine	39/298 (13)	
Saline	45/251 (18)	

* $p=0.001$, right-tailed Fisher's exact test

infected, whereas 88 (19%) of 455 metal-skin interfaces in older patients did so (RR, 0.85; Table 2). Half-pin fixation was more likely to become infected than wire fixation (25% vs 15%; RR, 1.61; $p=0.001$, right-tailed Fisher's exact test; Table 2).

DISCUSSION

The overall infection rate of our study was 18%, which was higher than the 9% reported in 44 children treated with external fixation for femoral fractures.⁴ Various infection rates were reported; it was 84% in children treated without regular dressing⁵ and 11% when oral antibiotics were prescribed.¹¹

Our infection rates in the diluted povidone-iodine and saline groups were comparable. The antibacterial activity of povidone-iodine may have been offset by its cytotoxic effect at the concentrations used in clinical practice.^{9,10} The solution may have been diluted by wound exudates resulting in loss of biological activity,¹² particularly in the first few months of fixation when the wounds were raw. Dressing for prolonged fixation may be less important, because of epithelialisation of the interface.

Children generally have better healing potential for bone and soft tissue injuries, but adults are better at taking care of the wounds. Infection rates were similar between younger patients with congenital or developmental deformities and older patients with trauma. Measures including adjustment of daily activities, clothing modifications, and self-dressing the wound may contribute favourably to healing.

Half-pin fixation has more metal-skin interfaces than does wire fixation and is more likely to be associated with tissue reactions and wound exudation. It is generally used for areas with abundant soft tissues such as the middle and upper thigh. Both soft-tissue movement and a thicker soft tissue envelope are associated with increased reactions and drainage, and thus a higher infection rate.¹³ Wires are generally used at periarticular areas with less soft tissue to form an envelope. They are placed near the hinge axis of a joint where movement of soft tissue is minimal. Half pins are more stable and entail fewer fixations for any given bone segment.

Classification of metal-skin interface infections is complicated and relies on subjective observations from patients.^{3,12} In our study, evaluation was mainly based on visual assessment by researchers; some patients were able to relate the condition of the wound at follow-up. The assumption that infection at each interface is independent is unlikely to be valid. It would have been more appropriate to compare the mean proportion of infections in each of the 2 groups or to use multiple random effects logistic regression analysis using the restricted maximum likelihood method.

CONCLUSION

Saline is as effective as diluted povidone iodine in protecting metal-skin interfaces against infection. Saline is recommended because it is cheaper, readily available, and has a low risk of skin hypersensitivity.

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